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(54) **IDENTIFYING BASE STATION TYPES**

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(22) Filed: **May 21, 2013**

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(51) **Int. Cl.**

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H04W 24/00	(2009.01)
H04W 4/22	(2009.01)
H04W 88/08	(2009.01)
H04W 4/02	(2009.01)
H04W 64/00	(2009.01)
H04W 84/04	(2009.01)

(52) **U.S. Cl.**

CPC . ***H04W 4/22*** (2013.01); *H04W 4/02* (2013.01); *H04W 64/00* (2013.01); *H04W 84/045* (2013.01); *H04W 88/08* (2013.01)

(58) **Field of Classification Search**

USPC 370/328, 338; 455/456.1, 456; 705/26

See application file for complete search history.

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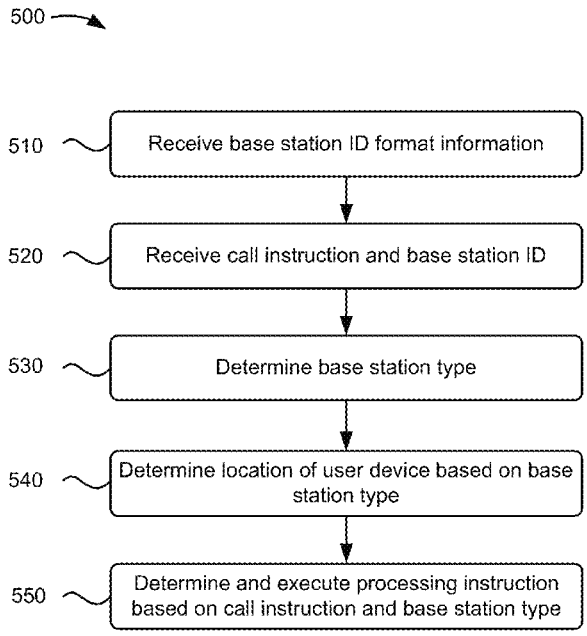
Primary Examiner — Andrew Lee

(57) **ABSTRACT**

One or more devices may receive information that identifies a format of an identifier of a network device. The format of the identifier may indicate a portion of the identifier that identifies a type of the network device. The one or more devices may receive the identifier of the network device based on a user device connecting with the network device to communicate via the network device; determine the type of the network device connected to the user device based on the portion of the identifier and a format of the identifier that identifies the type of network device; and execute a processing instruction based on the type of network device connected to the user device.

20 Claims, 8 Drawing Sheets



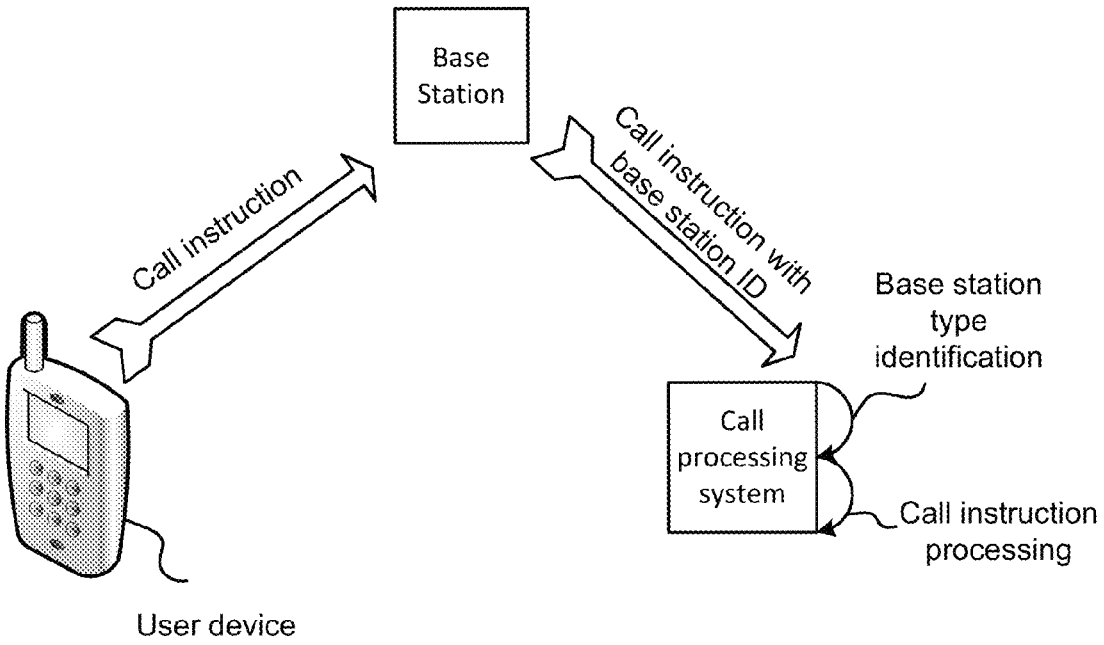

Base Station
Call instruction
Call instruction with base station ID
Base station type identification
Call processing system
Call instruction processing
User device

Fig. 1

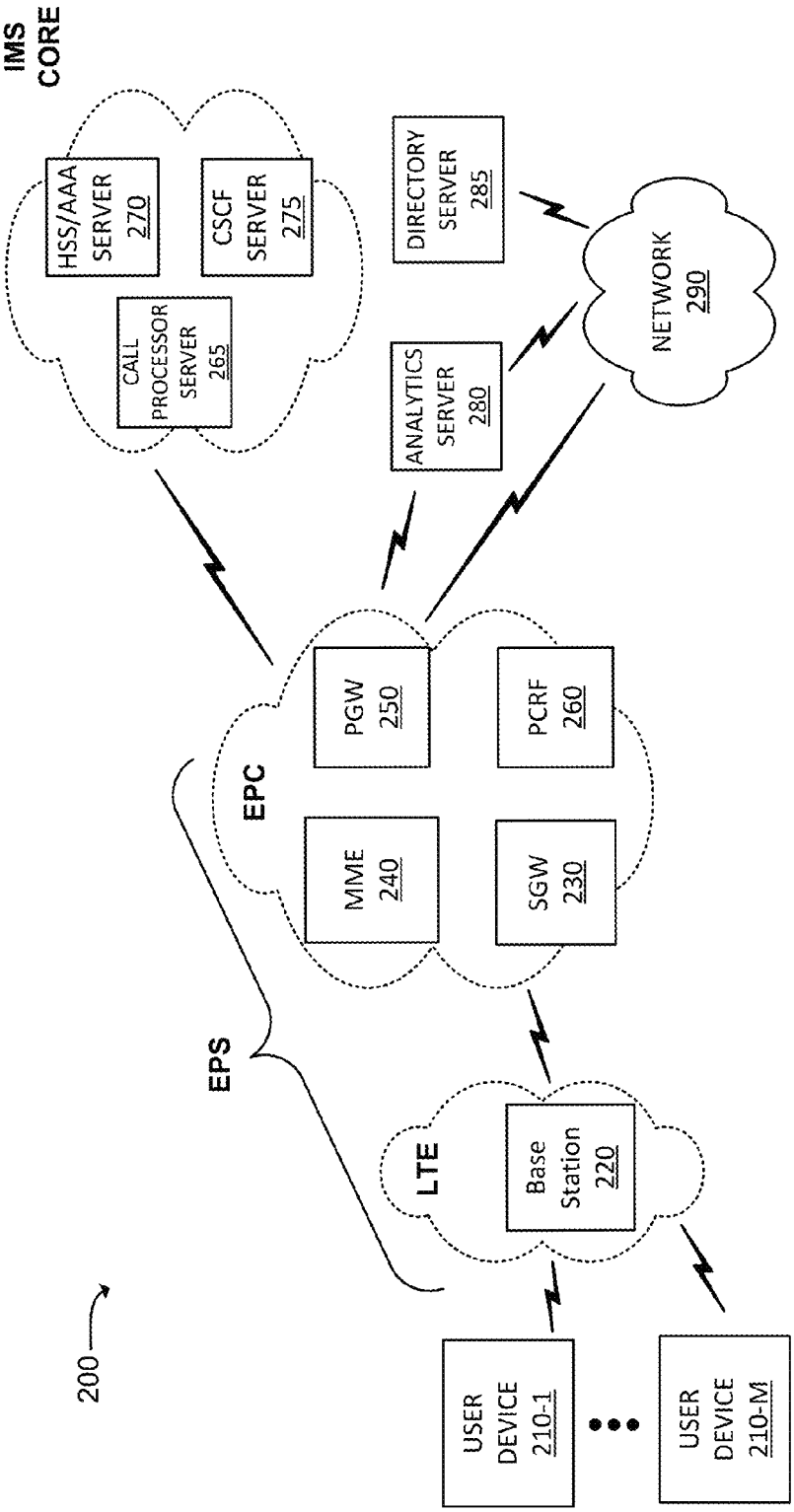

IMS CORE
HSS/AAA SERVER 270
CSCF SERVER 275
CALL PROCESSOR SERVER 265
DIRECTORY SERVER 285
ANALYTICS SERVER 280
NETWORK 290
EPC
PGW 250
PCRF 260
MME 240
SGW 230
EPS
LTE
Base Station 220
USER DEVICE 210-1
USER DEVICE 210-M
200

Fig. 2

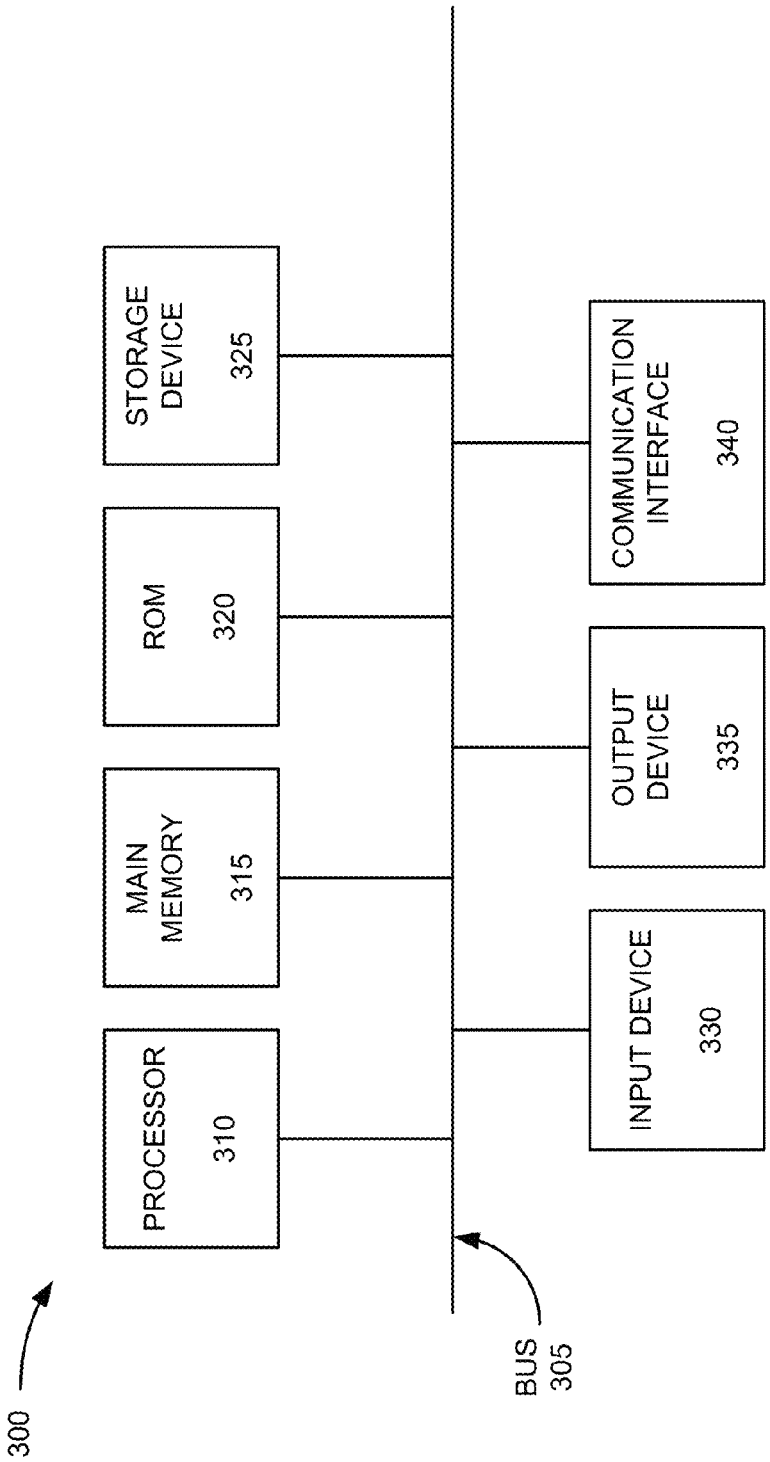

300
PROCESSOR
310
MAIN MEMORY
315
ROM
320
STORAGE DEVICE
325
BUS
305
INPUT DEVICE
330
OUTPUT DEVICE
335
COMMUNICATION INTERFACE
340

Fig. 3

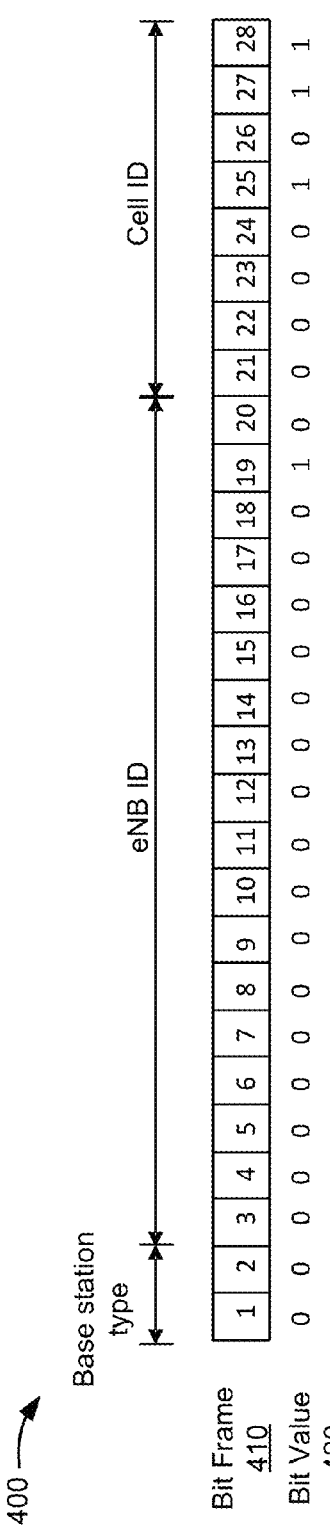


Fig. 4A

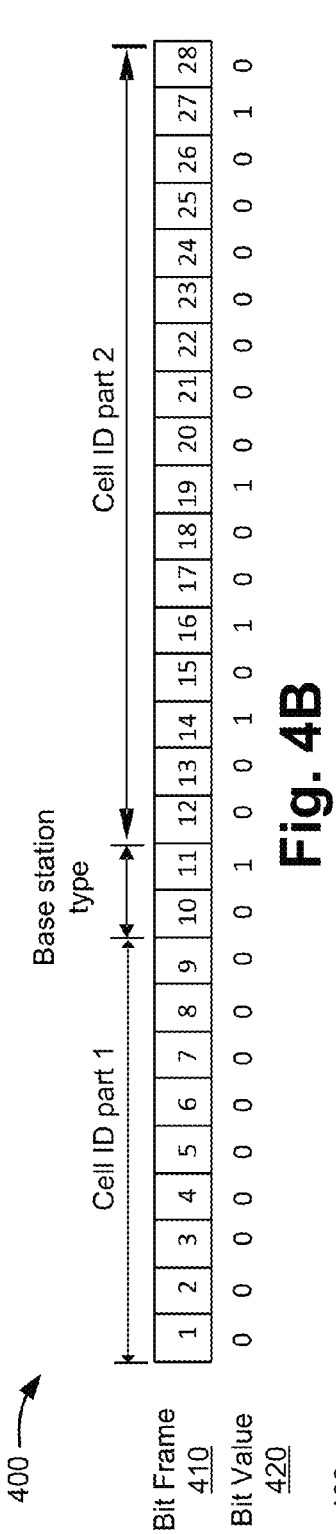


Fig. 4B

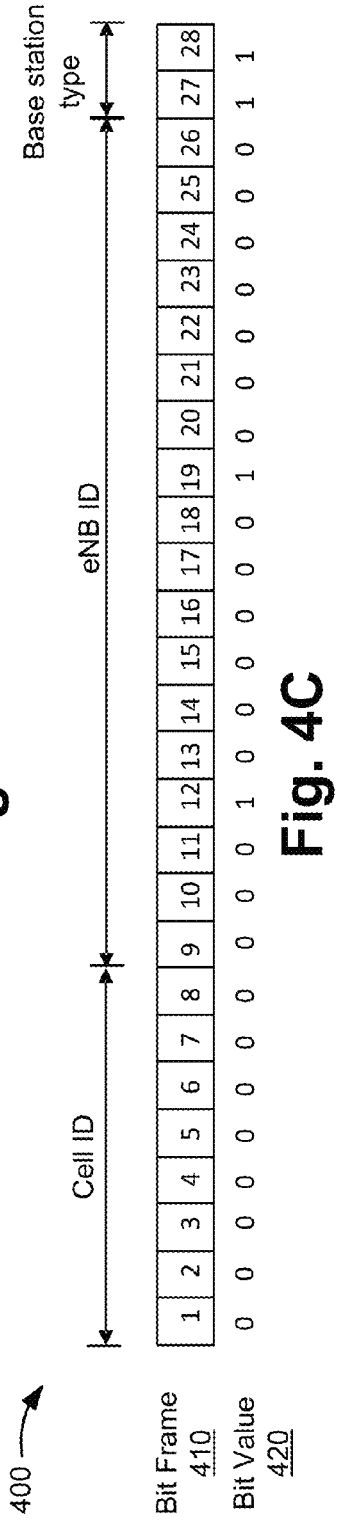


Fig. 4C

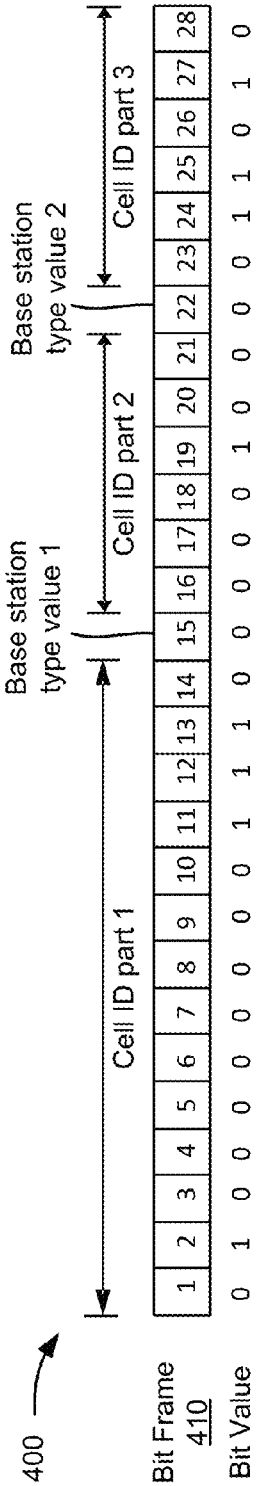

400
Bit Frame 410
Bit Value 420
Cell ID part 1
Base station type value 1
Cell ID part 2
Base station type value 2
Cell ID part 3
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
0 1 0 0 0 0 0 0 0 0 1 1 1 0 0 0 0 0 0 1 0 0 0 0 0 1 1 0 1 0

Fig. 4D

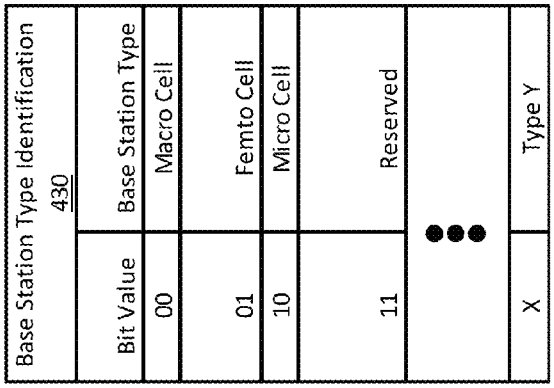

400
Base Station Type Identification 430
Bit Value
Base Station Type
00
Macro Cell
01
Femto Cell
10
Micro Cell
11
Reserved
X
Type Y

Fig. 4E

400

Location Determination Technique 440	
Base Station Type	Location Technique
Macro cell	-SUPL -Invoke GPS command on user device
Femto cell	Longtitude/lattitude coordinates associated with femto cell ID

Processing Instruction 450	
Rule	Instruction
Base station = Femto cell Call instruction = Emergency number	-Locate user device using femto cell location technique -Determine nearest emergency dispatch facility -Place call to nearest emergency dispatch facility
Base station = Macro cell Call instruction = emergency number	-Locate user device using marco cell location technique -Determine nearest emergency dispatch facility -Place call to nearest emergency dispatch facility
Base station = Femto cell Call instruction = #Pizza	-Locate user device using femto cell location technique -Determine nearest pizza merchant -Place call to nearest pizza merchant
Base station = Femto cell Call instruction = #PizzaList	-Locate user device using femto cell location technique -Determine list of nearest pizza merchants and associated promotions -Provide list of pizza merchants to user device -Provide promotions information to user device

Fig. 4F

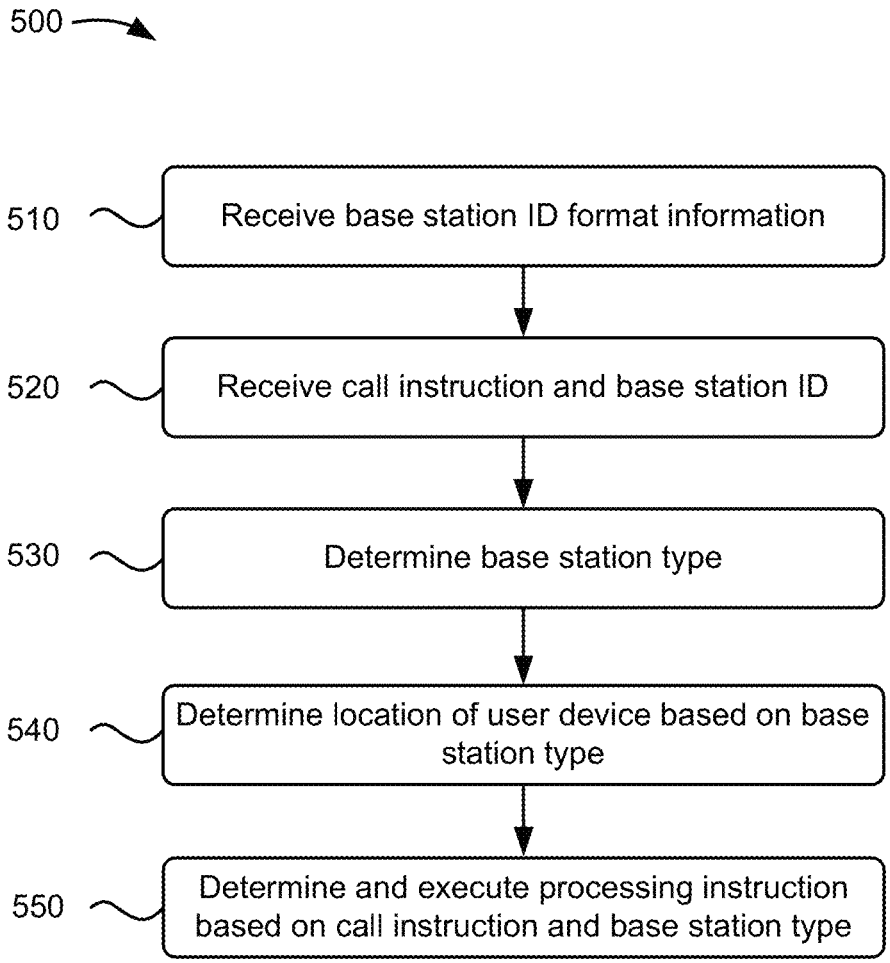

500
510
Receive base station ID format information
520
Receive call instruction and base station ID
530
Determine base station type
540
Determine location of user device based on base station type
550
Determine and execute processing instruction based on call instruction and base station type

Fig. 5

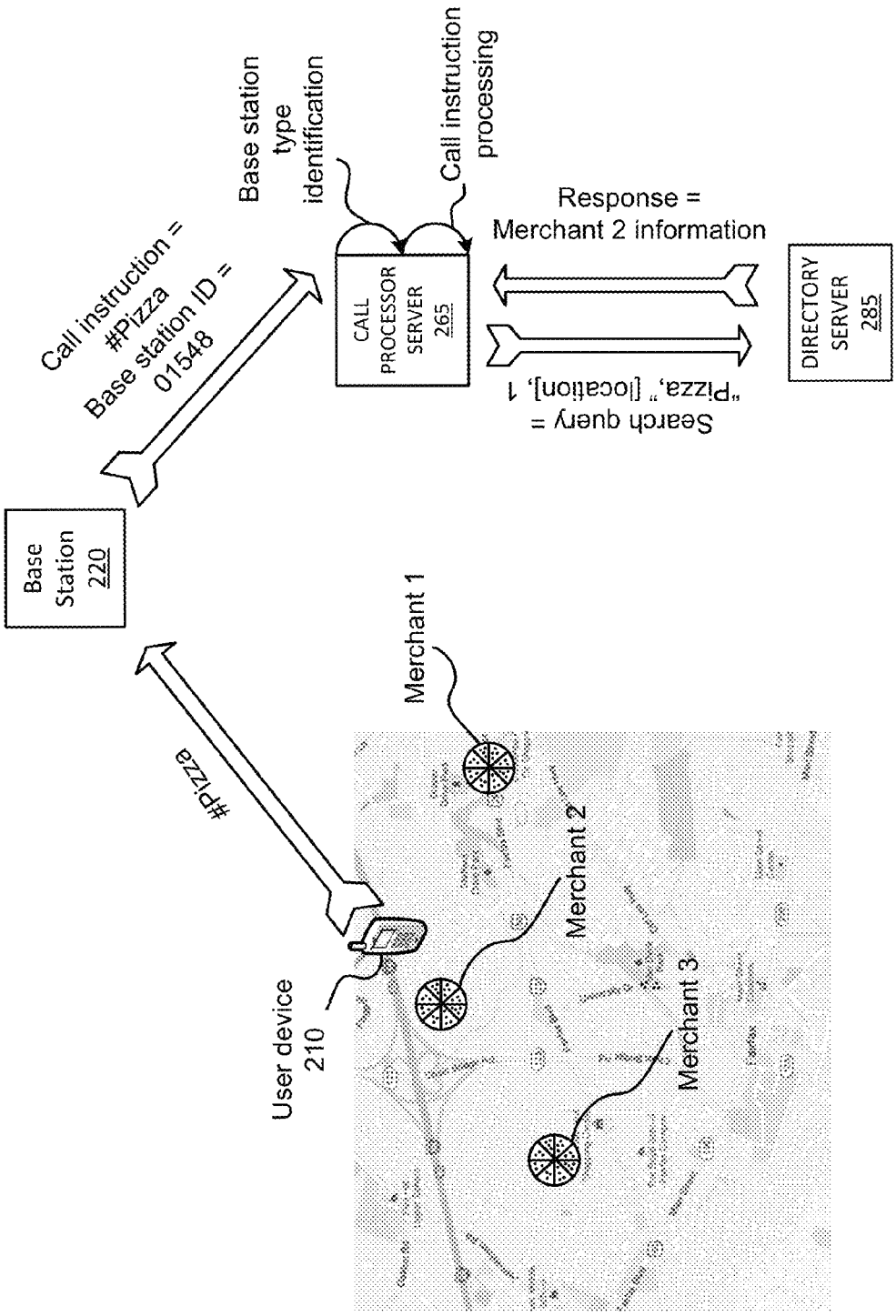

Base station type identification
Call instruction processing
Response = Merchant 2 information
Call instruction = #Pizza Base station ID = 01548
CALL PROCESSOR SERVER 265
DIRECTORY SERVER 285
Search query = "Pizza," [location], 1
Base Station 220
Merchant 1
#pizza
Merchant 2
User device 210
Merchant 3

Fig. 6

IDENTIFYING BASE STATION TYPES

BACKGROUND

User devices sometimes connect with network devices, such as base stations, to access a network to send/receive telephone calls and/or send/receive other types of communications. The type of base station connected to the user device may be unknown to a service provider of the network, thereby preventing the service provider to process a communication based on the type of base station.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an example overview of an implementation described herein;

FIG. **2** illustrates an example environment in which systems and/or methods, described herein, may be implemented;

FIG. **3** illustrates example components of a device that may be used within the environment of FIG. **2**;

FIGS. **4**A-**4**F illustrate an example data structure that may be stored by one or more devices in the environment of FIG. **2**;

FIG. **5** illustrates a flowchart of an example process for processing a call instruction based on a type of base station with which a user device connects; and

FIG. **6** illustrates an example implementation as described herein.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description refers to the accompanying drawings. The same reference numbers in different drawings may identify the same or similar elements.

Systems and/or methods, as described herein, may allow a call processing system to identify a type of base station (e.g., a macro cell type base station, a micro cell type base station, a small cell type base station, a femto cell type base station, or some other type of base station) with which a user device connects (e.g., to access a network and the call processing system) based on an identifier associated with the base station. Based on the type of base station, the call processing system may process a call instruction for the user device or execute some other network-related instruction. For example, based on the type of base station connected to the user device, the call processing system may apply a policy to the connection between the user device and the base station, apply different billing rates to an account of the user device, provide indications for display on the user device that indicate the type of base station connected to the user device, or execute some other network-related instruction.

FIG. **1** illustrates an example implementation, as described herein. In FIG. **1**, assume that a call processing system stores format information that allows the call processing system to identify a type of base station based on a format of an identifier (ID) associated with the base station (e.g., an Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Cell Global identifier (ECGI) or some other type of identifier). In some implementations, the identifier may include a quantity of bits and may have a format that identifies the type of the base station and/or some other information regarding the base station. For example, the first two bits of the identifier may include information that identifies the type of the base station whereas the remaining bits of the identifier may include information that identifies some other information regarding the base station. Alternatively, some other bit or bits of the identifier may include information that identifies the type of the base station.

As shown in FIG. **1**, a user device may attach to a base station to access a call processing system to perform a task (e.g., access a web page, place a telephone call, etc.). For example, the user device may provide a call instruction that the call processing system may process on behalf of the user device (e.g., to allow the user device to perform the task). In some implementations, the call instruction may be received in the form of a text message, a dialed telephone number, and/or a packet-based message using an application of the user device.

As shown in FIG. **1**, the base station may provide the call instruction to the call processing system (e.g., on behalf of the user device) and may provide an identifier of the base station with the call instruction to the call processing system. In some implementations, the call processing system may identify the type of base station based on the identifier and based on the format information.

In some implementations, the call processing system may process the call instruction based on the type of base station. For example, assume that the call instruction directs the user device to call a particular point of interest (POI) that is nearest to the geographic location (referred to as "location") of the user device (e.g., an emergency dispatch facility or merchant that sells a particular type of product). Given this assumption, the call processing system may locate the user device using a particular technique based on the type of base station connected to the user device. For example, the call processing system may locate the user device using a triangulation technique when the user device is connected to a macro cell type base station. Additionally or alternatively, the call processing system may locate the user device using longitude/latitude coordinates, associated with the base station, when the user device connects with a femto cell type base station (e.g., since the connection range of the femto cell type base station is within a particular threshold). Additionally or alternatively, the call processing system may or some other location determination technique based on the type of base station connected to the user device. In some implementations, the call processing system may process the call instruction by placing a telephone call, for the user device, to the nearest POI based on the geographic location of the user device.

As a result, the call processing system may identify base station types and may process a call instruction based on the base station type of the base station with which the user device connects. Further, analytics data may be stored to identify a quantity of user devices that are offloaded from a macro cell type base station to a femto cell type base station or other type of base station (e.g., to analyze the effectiveness and value of deploying femto cell type base stations to offload traffic from macro cell type base stations).

FIG. **2** is a diagram of an example environment **200** in which systems and/or methods described herein may be implemented. As shown in FIG. **2**, environment **200** may include user devices **210**, . . . , **210**-M (where M≥1), a base station **220**, a serving gateway **230** (referred to as "SGW **230**"), a mobility management entity device **240** (referred to as "MME **240**"), a packet data network (PDN) gateway (PGW) **250**, a policy charging and rules function server **260** (referred to as "PCRF **260**"), a call processing server **265**, a home subscriber server (HSS)/authentication, authorization, accounting (AAA) server **270** (referred to as an "HSS/AAA server **270**"), a call service control function (CSCF) server **275** (referred to as "CSCF server **275**"), an analytics server **280**, a directory server **285**, and a network **290**. The quantity

of devices and/or networks, illustrated in FIG. **2**, is provided for explanatory purposes only. In practice, there may be additional devices and/or networks; fewer devices and/or networks; different devices and/or networks; or differently arranged devices and/or networks than illustrated in FIG. **2**.

In some implementations, one or more of the devices of environment **200** may perform one or more functions described as being performed by another one or more of the devices of environment **200**. Devices of environment **200** may interconnect via wired connections, wireless connections, or a combination of wired and wireless connections.

Environment **200** may include an evolved packet system (EPS) that includes a long term evolution (LTE) network and/or an evolved packet core (EPC) that operate based on a third generation partnership project (3GPP) wireless communication standard. The LTE network may be a radio access network (RAN) that includes one or more base stations, such as eNodeBs (eNBs), via which user device **210** communicates with the EPC. The EPC may include SGW **230**, MME **240**, PGW **250**, and/or PCRF **260** that enables user device **210** to communicate with network **290** and/or an Internet protocol (IP) multimedia subsystem (IMS) core. The IMS core may include call processing server **265**, HSS/AAA server **270**, and CSCF server **275** and may manage authentication, connection initiation, account information, a user profile, etc. associated with user device **210**. As shown in FIG. **2**, the LTE network may include base station **220**. In some implementations, the EPC and IMS core may correspond to a call processing system as described in connection with FIG. **1**.

User device **210** may include a computation or communication device, such as a wireless mobile communication device that is capable of communicating with base station **220** and/or a network (e.g., network **290**). For example, user device **210** may include a radiotelephone, a personal communications system (PCS) terminal (e.g., that may combine a cellular radiotelephone with data processing and data communications capabilities), a personal digital assistant (PDA) (e.g., that can include a radiotelephone, a pager, Internet/intranet access, etc.), a smart phone, a laptop computer, a tablet computer, a camera, a personal gaming system, or another type of computation or communication device. User device **210** may send data to and/or receive data from network **290**.

Base station **220** may include one or more network devices that receive, process, and/or transmit traffic, such as audio, video, text, and/or other data, destined for and/or received from user device **210**. In an example implementation, base station **220** may be an eNB device and may be part of the LTE network. Base station **220** may receive traffic from and/or send traffic to network **290** via SGW **230** and PGW **250**. Base station **220** may send traffic to and/or receive traffic from user device **210** via an air interface. One or more of base stations **220** may be associated with a RAN, such as the LTE network. In some implementations, base station **220** may include a macro cell type base station, a micro cell type base station, a femto cell type base station, or some other type of base station.

In some implementations, base station **220** may have a particular connection range to service a particular geographic area. In some implementations, multiple base stations **220** may include a connection protocol that identify a particular base station **220** that may connect to user device **210** when the connection range of the multiple base stations **220** overlap. For example, base stations **220** may include a connection protocol that directs a femto cell type base station **220** to connect to user device **210** when user device **210** is in connection range of a femto cell type base station **220** and a macro cell type base station **220**. Additionally or alternatively, the connection protocol may direct an under-loaded base station **220** to connect to user device **210** to alleviate an overloaded base station **220**.

SGW **230** may include one or more network devices, such as a gateway, a router, a modem, a switch, a firewall, a network interface card (NIC), a hub, a bridge, a proxy server, an optical add-drop multiplexer (OADM), or some other type of device that processes and/or transfers traffic. SGW **230** may, for example, aggregate traffic received from one or more base stations **220** and may send the aggregated traffic to network **290** via PGW **250**. In one example implementation, SGW **230** may route and forward user data packets, may act as a mobility anchor for a user plane during inter-eNB handovers, and may act as an anchor for mobility between LTE and other 3GPP technologies.

MME **240** may include one or more network devices that perform operations associated with a handoff to and/or from the EPS. MME **240** may perform operations to register user device **210** with the EPS, to handoff user device **210** from the EPS to another network, to handoff a user device **210** from the other network to the EPS, and/or to perform other operations. MME **240** may perform policing operations for traffic destined for and/or received from user device **210**. MME **240** may authenticate user device **210** (e.g., via interaction with HSS/AAA server **270**).

PGW **250** may include one or more network devices, such as a gateway, a router, a modem, a switch, a firewall, a NIC, a hub, a bridge, a proxy server, an OADM, or some other type of device that processes and/or transfers traffic. PGW **250** may, for example, provide connectivity of user device **210** to external packet data networks by being a traffic exit/entry point for user device **210**. PGW **250** may perform policy enforcement, packet filtering, charging support, lawful intercept, and/or packet screening. PGW **250** may also act as an anchor for mobility between 3GPP and non-3GPP technologies.

PCRF **260** may include one or more network devices that store subscriber information, such as voice call and data rate plans or quotas for subscribers. PCRF **260** may provide network control regarding service data flow detection, gating, (Quality of Service) QoS, and/or flow based charging. Policies and rules regarding QoS may include policies and rules instructing user device **210** and/or network devices (e.g., base station **220**, SGW **230**, MME **240**, PGW **250**, etc.) to minimize packet loss, to implement a packet delay budget, to provide a guaranteed bit rate (GBR), to provide a particular latency, and/or to perform other activities associated with QoS. PCRF **260** may provide policies and rules to other network devices, such as HSS/AAA server **260** and/or PGW **250**, to implement network control. PCRF **260** may determine how a certain service data flow shall be treated, and may ensure that user plane traffic mapping and QoS is in accordance with a user's profile and/or network policies.

In some implementations, SGW **230**, MME **240**, PGW **250**, and/or PCRF **260** may apply and/or enforce connection policies and/or QoS treatments based on a type of base station **220** connected to user device **210**.

Call processor server **265** may include one or more computing devices, such as a server device or a collection of server devices. In some implementations, call processor server **265** may store base station ID information that may be used to identify a type of base station **220** with which user device **210** connects. For example, call processor server **265** may receive a base station ID from user device **210** and/or base station **220** when user device **210** provides a call instruction. In some implementations, call processor server **265** may

identify the type of base station based on the base station ID and process the call instruction based on the type of base station ID.

HSS/AAA server **270** may include one or more computing devices, such as a server device or a collection of server devices. In some implementations, HSS/AAA server **270** may manage, update, and/or store, in a memory associated with HSS/AAA server **270**, profile information associated with user device **210** that identifies types of base stations **220** with which user device **210** connects. Additionally or alternatively, HSS/AAA server **270** may manage, update, and/or store profile information that identifies applications and/or services that are permitted for and/or accessible by user device **210**, bandwidth or data rate thresholds associated with the applications or services, information associated with a user of user device **210** (e.g., a username, a password, a personal identification number (PIN), etc.), rate information, minutes allowed, and/or other information. Additionally, or alternatively, HSS/AAA server **270** may include a device that performs authentication, authorization, and/or accounting (AAA) operations associated with a communication connection with user device **210**. In some implementations, HSS/AAA server **270** may apply different billing rates to an account of user device **210** based on the type of base station **220** connected to user device **210**.

CSCF server **275** may include one or more computing devices, such as a server device or a collection of server devices. In some implementations, CSCF server **275** may process and/or route calls to and from user device **210** via the EPC. For example, CSCF server **275** may process calls, received from network **290**, that are destined for user device **210**. In another example, CSCF server **275** may process calls, received from user device **210**, that are destined for network **290**.

Analytics server **280** may include one or more computing devices, such as a server device or a collection of server devices. In some implementations, analytics server **280** may receive analytics information that identifies types of base stations **220** with which user devices **210** connect (e.g., based on information stored by HSS/AAA server **270**). In some implementations, the analytics information may be used to identify a quantity of user devices **210** that are offloaded from a macro cell type base station **220** to a micro type base station **220** (e.g., to analyze the effectiveness and value of deploying micro type base stations **220** to offload traffic from macro cell type base stations **220**).

Additionally or alternatively, the analytics information may be used to build a connection profile for user device **210** to analyze network usage by user device **210** by base station type. In some implementations, a network service plan may be offered to a user of user device **210** based on the usage of different types of base stations **220** by user device **210**. For example, the network service plan may offer to provide a particular amount of network usage (e.g., in bytes of data transferred to/from user device **210**) when user device **210** connects to a femto cell type base station **220**. Additionally or alternatively, the network service plan may offer to provide another amount of network usage when user device **210** connects to a macro cell type base station **220**.

Directory server **285** may include one or more computing devices, such as a server device or a collection of server devices. In some implementations, directory server **285** may store information that identifies location information (e.g., longitude and latitude coordinates, a street address, or the like) associated with a particular base station **220** (e.g., a femto cell type base station **220**, a micro type base station **220**, or some other type of base station **220** having a connection range below a particular threshold). Additionally or alternatively, directory server **285** may store information associated with a POI (e.g., an emergency dispatch facility, a merchant, a service provider, or the like). For example, directory server **285** may store location information, telephone information, and/or some other information that call processor server **265** may use to process a call instruction (e.g., when the call instruction includes an instruction to call a POI based on the location of user device **210**).

Network **290** may include one or more wired and/or wireless networks. For example, network **290** may include a cellular network, a public land mobile network (PLMN), a second generation (2G) network, a third generation (3G) network, a fourth generation (4G) network, a fifth generation (5G) network, and/or another network. Additionally, or alternatively, network **290** may include a wide area network (WAN), a metropolitan area network (MAN), a telephone network (e.g., the Public Switched Telephone Network (PSTN)), an ad hoc network, an intranet, the Internet, a fiber optic-based network, and/or a combination of these or other types of networks.

The quantity of devices and/or networks, illustrated in FIG. **2**, is not limited to what is shown. In practice, there may be additional devices and/or networks; fewer devices and/or networks; different devices and/or networks; or differently arranged devices and/or networks than illustrated in FIG. **2**. Also, in some implementations, one or more of the devices of environment **200** may perform one or more functions described as being performed by another one or more of the devices of environment **200**. Devices of environment **200** may interconnect via wired connections, wireless connections, or a combination of wired and wireless connections.

FIG. **3** illustrates example components of a device **300** that may be used within environment **200** of FIG. **2**. Device **300** may correspond to user device **210**, base station **220**, SGW **230**, MME **240**, PGW **250**, PCRF **260**, call processing server **265**, HSS/AAA server **270**, CSCF server **275**, analytics server **280**, and/or directory server **285**. Each of user device **210**, base station **220**, SGW **230**, MME **240**, PGW **250**, PCRF **260**, call processing server **265**, HSS/AAA server **270**, CSCF server **275**, analytics server **280**, and/or directory server **285** may include one or more devices **300** and/or one or more components of device **300**.

As shown in FIG. **3**, device **300** may include a bus **305**, a processor **310**, a main memory **315**, a read only memory (ROM) **320**, a storage device **325**, an input device **330**, an output device **335**, and a communication interface **340**.

Bus **305** may include a path that permits communication among the components of device **300**. Processor **310** may include a processor, a microprocessor, an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), or another type of processor that interprets and executes instructions. Main memory **315** may include a random access memory (RAM) or another type of dynamic storage device that stores information or instructions for execution by processor **310**. ROM **320** may include a ROM device or another type of static storage device that stores static information or instructions for use by processor **310**. Storage device **325** may include a magnetic storage medium, such as a hard disk drive, or a removable memory, such as a flash memory.

Input device **330** may include a component that permits an operator to input information to device **300**, such as a control button, a keyboard, a keypad, or another type of input device. Output device **335** may include a component that outputs information to the operator, such as a light emitting diode (LED), a display, or another type of output device. Commu-

nication interface **340** may include any transceiver-like component that enables device **300** to communicate with other devices or networks. In some implementations, communication interface **340** may include a wireless interface, a wired interface, or a combination of a wireless interface and a wired interface.

Device **300** may perform certain operations, as described in detail below. Device **300** may perform these operations in response to processor **310** executing software instructions contained in a computer-readable medium, such as main memory **315**. A computer-readable medium may be defined as a non-transitory memory device. A memory device may include memory space within a single physical storage device or memory space spread across multiple physical storage devices.

The software instructions may be read into main memory **315** from another computer-readable medium, such as storage device **325**, or from another device via communication interface **340**. The software instructions contained in main memory **315** may direct processor **310** to perform processes that will be described later. Alternatively, hardwired circuitry may be used in place of or in combination with software instructions to implement processes described herein. Thus, implementations described herein are not limited to any specific combination of hardware circuitry and software.

In some implementations, device **300** may include additional components, fewer components, different components, or differently arranged components than are shown in FIG. **3**.

FIGS. **4**A-**4**F illustrate an example data structure **400** that may be stored by one or more devices in environment **200**. In some implementations, data structure **400** may be stored in a memory of call processor server **265**. In some implementations, data structure **400** may be stored in a memory separate from, but accessible by, call processor server **265**. In some implementations, data structure **400** may be stored by some other device in environment **200**, such as user device **210**, base station **220**, SGW **230**, MME **240**, PGW **250**, PCRF **260**, HSS/AAA server **270**, CSCF server **275**, analytics server **280**, and/or directory server **285**.

A particular instance of data structure **400** may contain different information and/or fields than another instance of data structure **400**. In some implementations, data structure **400** may store information identifying a format of a base station identifier that call processor server **265** may use to determine a type of base station connected to user device **210**. Additionally or alternatively, data structure **400** may store information identifying location techniques that call processor server **265** may use to determine a location of user device **210** based on the type of base station **220** connected to user device **210**. Additionally or alternatively, data structure **400** may store information identifying a processing instruction that call processor server **265** may execute based on the type of base station connected to user device **210** and based on a call instruction provided by user device **210**.

As shown in FIGS. **4**A-**4**F, data structure **400** may include bit frame field **410**, bit value field **420**, base station identification field **430**, location determination technique field **440**, and processing instruction field **450**.

Bit frame field **410** may include information identifying a particular bit associated with a base station identifier. For example, as shown in FIG. **4**A, the base station identifier may be 28 bits in length. In some implementations, the base station identifier may have some other length. As shown in FIG. **4**A, each bit frame may include a particular bit value as shown in bit value field **420**. In some implementations, particular bit frames may store bit values that identify a type of base station **220** associated with the base station identifier. For example, the bit values stored by the first two bit frames may indicate the type of base station **220**. The bit values stored by bit frames **3**-**20** may indicate some other information relating to base station **220** (e.g., an eNB ID). The bit values for frames **21**-**28** may indicate some other information relating to base station **220** (e.g., an identifier of a cell, associated with base station **220**, such as a cell ID). In FIGS. **4**A-**4**E, assume that the bit values "00" indicate a macro cell type base station **220** and that the bit values "01" indicate a femto cell type base station **220** (e.g., when the bit values are stored by bit frames that indicate the base station type). Given these assumptions, call processor server **265** may identify a macro cell type base station **220** based on the base station identifier shown in FIG. **4**A (e.g., since the bit frames that indicate the base station type store the bit values "00." In some implementations, the format of the base station identifier may vary from what is shown in FIG. **4**A.

For example, referring to FIG. **4**B, bit values stored by bit frames **10**-**11** may indicate the base station type. As further shown in FIG. **4**B, bit frames **1**-**9** may store bit values identifying a first portion of a cell ID while bit frames **12**-**28** may store bit values identifying a second portion of the cell ID. In some implementations, call processor server **265** may identify a femto cell type base station **220** based on the base station identifier shown in FIG. **4**B (e.g., since the base station type is identified by the bit values "01"). In some implementations, other bit frames may store bit values that identify the base station type. For example, referring to FIG. **4**C, the final bit frames of the bit identifier may store bit values that indicate the base station type. As shown in FIG. **4**C, the bit frames **27**-**28** may store bit values that indicate the base station type.

In some implementations, the bit values that identify the base station type may be stored in bit frames that are not contiguous (i.e. non-adjacent). For example, referring to FIG. **4**D, a first bit value that identifies that base station type may be stored by bit frame **15** while a second bit value that identifies the base station type may be stored by bit frame **22**. In the example of FIG. **4**D, call processor server **265** may identify the base station type based on the bit values "0" and "1." In some implementations, the base station identifier may include any number of bit frames and have any number of bit frames that may identify the base station type.

In some implementations, each format of the base station ID shown in FIGS. **4**A-**4**D may include a particular identifier, such as a format ID. In some implementations, different user devices **210** may be associated with different format IDs (e.g., based on a user device ID of user device **210**). That is, call processor server **265** may use a particular format of the base station ID (e.g., the format shown in FIG. **4**A) to identify the type of base station **220** connected to one user device **210**, and may use another format of the base station ID (e.g., the format shown in FIG. **4**B) to identify the type of base station **220** connected to another user device **210**.

While FIGS. **4**A-**4**D illustrate that two bit frames in a base station identifier may identify the base station type, in practice, any number of bit frames may be used to identify the base station type. Also, a particular set of bit values in a base station identifier may be associated with a particular base station type. As an example, bit values 0001-1000 may be associated with a femto cell type, whereas bit values and 1001-10000 may be associated with a macro cell type base station. Also, one or more decimal ranges, associated with bit values, may indicate the base station type (e.g., 0.000001-0.100001 may indicate a femto cell type base station). Further, data structure **400** may store multiple base station identifiers associated with a particular base station type.

Referring to FIG. **4**E, base station identification field **430** may store information that identifies the base station type based on bit values. As shown in FIG. **4**E, base station identification field **430** may identify that the bit values "00" correspond to a macro cell type base station **220**, the bit values "01" may correspond to the femto cell type base station **220**, and the bit values "10" may correspond to the micro cell type base station **220**. In some implementations, base station identification field **430** may store any number of bit values to identify any number of base station types. In some implementations, different bit values may correspond to different base station types for different user devices **210** (e.g., based on the user device ID of user device **210**). That is, the bit values "00" may correspond to a macro cell type base station **220** for one user device **210**, whereas the bit values "00" may correspond to a femto cell type base station for another user device **210**.

Referring to FIG. **4**F, location determination technique field **440** may store information that identifies a location determination technique that call processor server **265** may use to identify a location of user device **210** based on the type of base station **220** that is connected to user device **210**. For example, for a user device **210** that is connected to a macro cell type base station **220** (or a base station **220** having a connection range above a particular threshold), location determination technique field **440** may include information to direct call processor server **265** to use a secure user plane location (SUPL) to locate user device **210** via an internet protocol. Additionally or alternatively, location determination technique field **440** may include information to direct call processor server **265** to use triangulation techniques to locate user device **210**. Additionally, or alternatively, location determination technique field **440** may include information to direct call processor server **265** to invoke a global positioning system (GPS) device on user device **210** to receive location information of user device **210** (e.g., longitude and latitude coordinates, a street address, and/or some other information that identifies the location of user device **210**).

As further shown in FIG. **4**F (e.g., for a user device **210** that is connected to a femto cell type base station **220** or some other type of base station **220** having a connection range below a particular threshold), location determination technique field **440** may include information to direct call processor server **265** to determine the location of user device **210** based on location information associated with base station **220** (e.g., longitude and latitude coordinates, a street address, and/or some other information that identifies the location of base station **220**). For example, call processor server **265** may determine the longitude and latitude coordinates of base station **220** based on a cell ID portion of the base station ID of base station **220** and based on information stored by directory server **285** that identifies the longitude and latitude coordinates associated with the cell ID. As a result, call processor server **265** may determine the location of user device **210** without performing triangulation techniques or other processes that may strain user device **210** (e.g., when user device **210** is connected to a femto cell type base station **220**).

As described above, call processor server **265** may process a call instruction based on the base station type. For example, processing instruction field **450** may include information that identifies how call processor server **265** may process a particular call instruction based on the type of base station **220** with which user device **210** connects. As described above, the call instruction may be received in the form of a text message, a dialed telephone number, and/or in the form of a packet-based message using an application of user device **210**.

As shown in FIG. **4**F, processing instruction field **450** may store a rule having criteria for a call instruction and a corresponding instruction when the criteria are met. As an example, processing instruction field **450** may store criteria, such as "base station=femto cell" and "call instruction=emergency number." Further, processing instruction field **450** may store an instruction that call processor server **265** may execute to process a call instruction when the criteria of the call instruction are met. For example, when the corresponding criteria are met (e.g., when call processor server **265** receives a call instruction to call an emergency number from a user device **210** that is connected to a femto cell type base station **220**), processing instruction field **450** may store an instruction to direct call processor server **265** to locate user device **210** using the location technique for femto cell type base stations **220** indicated by location determination technique field **440**.

Further, processing instruction field **450** may store an instruction to direct call processor server **265** to determine the nearest emergency dispatch facility (e.g., based on the location of user device **210** and based on information stored by directory server **285**) and to place a call to the emergency dispatch facility (e.g., by communicating with CSCF server **275** to place the call). For example, call processor server **265** may provide a search query to directory server **285** with the search value "emergency dispatch, [location]," where [location] includes information identifying the location of user device **210** (e.g., a street address, longitude/latitude coordinates, and/or some other information that identifies location). In some implementations, directory server **285** may provide a response to the search query that includes information regarding the emergency dispatch facility closest to the location of user device **210** (e.g., a street address, a telephone number, a routing protocol used to route call to the emergency dispatch facility, etc.).

As another example, processing instruction field **450** may store a rule having the criteria "base station=macro cell" and "call instruction=emergency number." Processing instruction field **450** may store corresponding instructions to direct call processor server **265** (e.g., when call processor server **265** receives a call instruction meeting the criteria), to locate user device **210** using a particular location technique for user devices **210** connected to a macro cell type base station (e.g., based on information stored by location determination technique field **440**). Further, processing instruction field **450** may store an instruction to direct call processor server **265** to determine the nearest emergency dispatch facility (e.g., based on the location of user device **210** as determined using the particular location determination technique) and to place a call to the nearest emergency dispatch facility.

As another example, processing instruction field **450** may store a rule having the criteria "base station=femto cell" and "call instruction=#PizzaList." Processing instruction field **450** may store corresponding instructions to direct call processor server **265** (e.g., when call processor server **265** receives a call instruction meeting the criteria) to locate user device **210** (based on the type of base station **220** connected to user device **210** and the location technique indicated by location determination technique field **440**), determine a list of pizza merchants and a list of promotions associated with the pizza merchants, and provide the list if pizza merchants and the list of promotions to user device **210** for display on user device **210**. For example, call processor server **265** may provide a search query to directory server **285** with the search value "pizza [location]," where [location] includes information identifying the location of user device **210**." In some implementations, directory server **285** may provide a response to the search query that includes information regard-

ing a list of a particular number of pizza merchants within a particular threshold distance of the location of user device **210**.

In some implementations, the particular number of merchants in the list and the particular threshold distance may be based on user preference information stored by HSS/AAA server **270** and/or based on some other information included in the call instruction. For example, the call instruction may identify the particular number of merchants and/or the threshold distance.

As another example, processing instruction field **450** may store a rule having the criteria "base station=femto cell" and "call instruction=#Pizza." Processing instruction field **450** may store corresponding instructions to direct call processor server **265** (e.g., when call processor server **265** receives a call instruction meeting the criteria) to locate user device **210** using a particular location determination technique (e.g., based on the type of base station **220** connected to user device **210** and the particular location technique indicated by location determination technique field **440**). Processing instruction field **450** may further store an instruction to direct call processor server **265** to determine the nearest pizza merchant (e.g., based on a location of user device **210** determined using the particular location determination technique) and to place a call to the nearest pizza merchant.

While particular fields are shown in a particular format in data structure **400**, in practice, data structure **400** may include additional fields, fewer fields, different fields, or differently arranged fields than are shown in FIGS. **4**A-**4**F. For example, data structure **400** may store information that identifies a policy and/or a QoS treatment to apply to a connection between user device **210** and devices in environment **200** based on the type of base station **220** connected to user device **210**. Additionally or alternatively, data structure **400** may store information that identifies billing rates to apply to an account of user device **210** based on the type of base station **220** connected to user device **210**. Additionally or alternatively, data structure **400** may store analytics information that identifies network load offloaded from a macro cell type cell base station **220** to a femto cell type cell base station **220**. Additionally or alternatively, data structure **400** may store additional information related to a base station identifier, such as a mobile country code (MCC), a mobile network code (MNC), and/or some other information.

FIG. **5** illustrates a flowchart of an example process for processing a call instruction based on a type of base station **220** with which user device **210** connects. In one implementation, process **500** may be performed by one or more components of call processor server **265**. In another implementation, some or all of blocks of process **500** may be performed by one or more components of another device in environment **200** (e.g., user device **210**, base station **220**, SGW **230**, MME **240**, PGW **250**, PCRF **260**, HSS/AAA server **270**, CSCF server **275**, analytics server **280**, and/or directory server **285**), or a group of devices including or excluding call processor server **265**.

As shown in FIG. **5**, process **500** may include receiving base station ID format information (block **510**). For example, call processor server **265** may receive the base station ID format information from an operator of call processor server **265**. In some implementations, the base station ID format information may identify the format of the base station ID and may identify particular bit frames of the base station ID that indicate the type of base station **220** associated with the base station ID (e.g., as described above with respect to FIGS. **4**A-**4**D). In some implementations, the base station ID format information may also be provided to base stations **220** such that base stations **220** may each format respective base station IDs in accordance with the base station ID format information.

Process **500** may also include receiving a call instruction and a base station ID (block **520**). For example, call processor server **265** may receive a call instruction from user device **210**, via base station **220**, and the base station ID from the base station **220** connected to user device **210** (e.g., when base station **220** provides the call instruction to call processor server **265**). In some implementations, the call instruction may be received in the form of a text message, a dialed telephone number, and/or in the form of a packet-based message using an application of the user device. In some implementations, call processor server **265** may receive the base station ID without receiving the call instruction. For example, base station **220** may provide the base station ID to call processor server **265** when user device **210** connects with base station **220**, such as when user device **210** enters a connection range of user device **210**.

Process **500** may further include determining a base station type (block **530**). For example, call processor server **265** may determine the type of base station **220** connected to user device **210** based on the base station ID and the format information of the base station ID. Some examples of determining the type of base station **220** connected to user device **210** are described above with respect to FIGS. **4**A-**4**D.

Process **500** may also include determining the location of the user device based on the base station type (block **540**). For example, call processor server **265** may determine the location of user device **210** using a particular location determination technique based on the type of base station **220** connected to user device **210**. Some examples of determining the location of user device **210** using a particular location determination technique are described above with respect to FIG. **4**F.

Process **500** may further include determining and executing a processing instruction based on the call instruction and the base station type (block **550**). For example, call processor server **265** may determine the processing instruction when criteria are met (e.g., based on information stored by processing instruction field **450**). Call processor server **265** may execute the processing instruction based on determining the processing instruction. Some examples of determining and executing a processing instruction are described above with respect to FIG. **4**F.

As described above with respect to block **520**, call processor server **265** may receive the base station ID without receiving the call instruction, such as when base station **220** connects to user device **210**. As a result, call processor server **265** may identify the location of user device **210** based on the base station type and may store the location of user device **210** such that call processor server **265** may process a call instruction received at a later time after the location of user device **210** has been determined. Further, call processor server **265** may provide an indication to user device **210** for display that identifies information regarding the base station **220** connected to user device **210** (e.g., the type of base station **220**, a billing rate associated with usage of base station **220**, etc.). In some implementations, call processor server **265** may provide the indication to user device **210** without receiving a call instruction from user device **210** (e.g., when call processor server **265** receives a base station ID from base station **220** when user device **210** connects to base station **220**, such as when user device **210** enters a connection range of base station **220**).

While a particular series of blocks has been described above with regard to FIG. **5**, the operations, data flows, and/or the order of the blocks may be modified in other implemen-

tations. Further, non-dependent operations and/or data flows may be performed in parallel. As described above, some portions of process **500** may be performed by some other device in environment **200**. For example, SGW **230**, MME **240**, PGW **250**, and/or PCRF **260** may receive base station ID format information and a base station ID to identify a base station type to apply different QoS treatments or different policies based on the base station type. Alternatively, call processor server **265** may provide SGW **230**, MME **240**, PGW **250**, and/or PCRF **260** with information identifying the base station type.

In some implementations, HSS/AAA server **270** may use the information identifying the base station type to apply different billing rates to an account of user device **210** (e.g., apply one billing rate when user device **210** is connected to a macro cell type base station and apply another billing rate when user device **210** is connected to a femto cell type base station). In some implementations, analytics server **280** may use the information identifying the base station type to analyze the effectiveness of femto cells offloading network load from macro cells (e.g., to plan for deployment of additional femto cells to alleviate overloaded macro cells to plan for decommissioning of under-loaded femto cells). In some implementations, HSS/AAA server **270** and/or analytics server **280** may receive base station ID format information and a base station ID to identify a base station type. Alternatively, call processor server **265** may provide HSS/AAA server **270** and/or analytics server **280** with information identifying the base station type.

FIG. **6** illustrates an example implementation as described herein. In FIG. **6**, assume that user device **210** is located at a particular location as shown. Further, assume that user device **210** connects to a femto cell type base station **220** to provide a call instruction for processing by call processor server **265**. As shown in FIG. **6**, user device **210** may provide a call instruction, such as "#Pizza" (e.g., via dialing a particular dialing sequence on a keypad of user device **210**, via a text message, via a packet-based message using an application on user device **210**, or via some other technique). In FIG. **6**, assume that the call instruction causes call processor server **265** to place a call for user device **210** to the nearest merchant that sells pizza. Further, assume that three pizza merchants are within a particular range of user device **210** (e.g., as shown in FIG. **6**). Further, assume that merchant **2** is closest to user device **210**.

As shown in FIG. **6**, call processor server **265** may receive the call instruction and may receive a base station ID associated with base station **220**. In some implementations, call processor server **265** may identify the type of base station **220** and may process the call instruction (e.g., in accordance with process **500** as described above). For example, call processor server **265** may locate user device **210** using a location determination technique based on the type of base station **220** (e.g., a particular location determination technique for femto cell type base stations as identified in location determination technique field **440**). In some implementations, call processor server **265** may use the particular location determination technique for a femto cell type base station **220** to determine the location of user device **210** based on location information associated with base station **220** (e.g., longitude and latitude coordinates, a street address, and/or some other information that identifies the location of base station **220**). For example, call processor server **265** may determine the longitude and latitude coordinates of base station **220** based on a cell ID portion of the base station ID of base station **220** and based on information stored by directory server **285** that identifies the longitude and latitude coordinates associated with the cell ID.

Further, call processor server **265** may provide a search query to directory server **285**, such as "Pizza," [location, 1]. In some implementations, the search query may direct directory server **285** to search for the nearest merchant (e.g., as indicated by the value 1), with respect to the location of user device **210**, that is categorized as a merchant that sells pizza. In some implementations, the search query may have some other form, such as "Pizza," [location, 5] to direct directory server **285** to search for the 5 nearest pizza merchants (e.g., as indicated by the value 5). As shown in FIG. **6**, the directory server may provide a response to call processor server **265**, such as a response that identifies information associated with merchant **2** (e.g., the closest pizza merchant to user device **210**). Additionally or alternatively, the response may include a list of pizza merchants such that call processor server **265** may determine the nearest pizza merchant to user device **210**. In some implementations, call processor server **265** may communicate with CSCF server **275** to place a call for user device **210** to merchant **2**.

In some implementations, call processor server **265** may communicate with CSCF server **275** to place a call to a merchant based on a direction of travel of user device **210**. For example, assume that call processor server **265** is traveling towards merchant **1** and away from merchant **2** (e.g., based on identifying that user device **210** disconnects from a particular base station **220** and connects to another base station **220** that is in the direction toward merchant **1**). Given this assumption, call processor server **265** may process the call instruction by placing a call to merchant **1**.

While a particular example is shown in FIG. **6**, it will be apparent that the above description is merely an example implementation and call processor server **265** may process a call instruction based on some other criteria not described above.

As described above, call processor server **265** may identify a type of base station **220** connected to user device **210** and may process a call instruction based on the base station type. Additionally or alternatively, call processor server **265** may provide indications for display on user device **210** that indicate the type of base station **220** connected to user device **210**, billing rates associated with base station **220**, etc. Further, analytics data may be stored by analytics server **280** to identify a number of user devices **210** that are offloaded from a macro cell type base station **220** to a femto cell type base station **220** or some other type of base station **220** (e.g., to analyze the effectiveness and value of deploying femto cell type base stations **220** to offload traffic from macro cell type base stations **220**).

In some implementations, SGW **230**, MME **240**, PGW **250**, and/or PCRF **260** may identify the base station type to apply a policy or QoS treatment to the connection between user device **210** and devices in, or communicating via, environment **200**. Additionally or alternatively, HSS/AAA server **270** may identify the base station type to apply different billing rates to an account associated with user device **210**.

The foregoing description provides illustration and description, but is not intended to be exhaustive or to limit the possible implementations to the precise form disclosed. Modifications and variations are possible in light of the above disclosure or may be acquired from practice of the implementations.

It will be apparent that different examples of the description provided above may be implemented in many different forms of software, firmware, and hardware in the implementations illustrated in the figures. The actual software code or specialized control hardware used to implement these examples is not limiting of the implementations. Thus, the

operation and behavior of these examples were described without reference to the specific software code—it being understood that software and control hardware can be designed to implement these examples based on the description herein.

Even though particular combinations of features are recited in the claims and/or disclosed in the specification, these combinations are not intended to limit the disclosure of the possible implementations. In fact, many of these features may be combined in ways not specifically recited in the claims and/or disclosed in the specification. Although each dependent claim listed below may directly depend on only one other claim, the disclosure of the possible implementations includes each dependent claim in combination with every other claim in the claim set.

No element, act, or instruction used in the present application should be construed as critical or essential unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items and may be used interchangeably with "one or more." Where only one item is intended, the term "one" or similar language is used. Further, the phrase "based on" is intended to mean "based, at least in part, on" unless explicitly stated otherwise.

What is claimed is:

1. A method comprising:

receiving, by one or more devices, information that identifies a format of an identifier of a network device,

the format of the identifier indicating one or more bits of the identifier that identifies a type of the network device;

receiving, by the one or more devices, the identifier of the network device based on a user device connecting with the network device;

determining, by the one or more devices, the type of the network device connected to the user device based on a bit value stored by the one or more bits, of the identifier that identifies the type of the network device, as indicated by the format of the identifier;

receiving, by the one or more devices, a call instruction,

the call instruction directing the one or more devices to identify a point of interest (POI) based on a location of the user device;

determining, by the one or more devices, a processing instruction based on the call instruction and the type of the network device,

the processing instruction being associated with the POI; and

executing, by the one or more devices, the processing instruction based on the type of the network device connected to the user device.

2. The method of claim **1**, further comprising:

identifying the POI based on the location of the user device,

where executing the processing instruction includes providing information regarding the POI to the user device or placing a call to the POI for the user device.

3. The method of claim **1**, where the processing instruction directs the one or more devices to determine the location of the user device based on the type of the network device, and

where executing the processing instruction includes determining the location of the user device based on the type of the network device.

4. The method of claim **3**, where determining the location of the user device includes determining the location of the user device based on a particular location determination technique,

the particular location determination technique being based on the type of the network device,

the particular location determination technique being based on one or more of: a secure user plane location (SUPL) protocol, longitude and latitude coordinates associated with the network device, or global positioning system (GPS) coordinates provided by the user device.

5. The method of claim **1**, where the processing instruction directs the one or more devices to apply a quality of service (QoS) treatment or policy to a connection associated with the user device, and

where executing the processing instruction includes applying the QoS treatment or policy to the connection associated with the user device.

6. The method of claim **1**, where the processing instruction directs the one or more devices to apply a particular billing rate to an account of the user device based on the type of the network device connected to the user device, and

where executing the processing instruction includes applying the particular billing rate to the account of the user device based on the type of the network device connected to the user device.

7. The method of claim **1**, where the processing instruction directs the one or more devices to store analytics information that identifies a measure of network load offloaded from the network device, and

where executing the processing instruction includes storing the analytics information.

8. The method of claim **1**, where the type of the network device includes a macro cell network device, a micro cell network device, a femto cell network device, or an eNodeB network device.

9. A system comprising:

one or more devices, comprising one or more memories and one or more processors, to:

receive information that identifies a format of an identifier of a network device,

the format of the identifier indicating a portion of the identifier that identifies a type of the network device;

receive the identifier of the network device based on a user device connecting with the network device to communicate via the network device;

determine the type of the network device connected to the user device based on the portion of the identifier, that identifies the type of the network device, as indicated by the format of the identifier;

receive a call instruction,

the call instruction directing the one or more devices to identify a point of interest (POI) based on a location of the user device;

determine a processing instruction, relating to the POI, based on the call instruction and the type of the network device; and

execute the processing instruction based on the type of the network device connected to the user device.

10. The system of claim **9**, where the one or more devices are further to:

identify the POI based on the location of the user device,

where, when executing the processing instruction, the one or more devices are further to provide information regarding the POI to the user device or place a call to the POI for the user device.

11. The system of claim **9**, where the processing instruction directs the one or more devices to determine the location of the user device based on the type of the network device, and

where, when executing the processing instruction, the one or more devices are further to determine the location of the user device based on the type of the network device.

12. The system of claim **11**, where, when determining the location of the user device, the one or more devices are further to determine the location of the user device based on a particular location determination technique,

the particular location determination technique being based on the type of the network device,

the particular location determination technique being based on one or more of: a secure user plane location (SUPL) protocol, longitude and latitude coordinates associated with the network device, or global positioning system (GPS) coordinates provided by the user device.

13. The system of claim **9**, where the processing instruction directs the one or more devices to apply a quality of service (QoS) treatment or policy to a connection associated with the user device, and

where, when executing the processing instruction, the one or more devices are further to apply the QoS treatment or policy to the connection associated with the user device.

14. The system of claim **9**, where the processing instruction directs the one or more devices to apply a particular billing rate to an account of the user device based on the type of the network device connected to the user device, and

where, when executing the processing instruction, the one or more devices are further to apply the particular billing rate to the account of the user device based on the type of the network device connected to the user device.

15. The system of claim **9**, where the processing instruction directs the one or more devices to store analytics information that identifies a measure of network load offloaded from the network device, and

where, when executing the processing instruction, the one or more devices are further to store the analytics information.

16. A non-transitory computer-readable medium for storing instructions, the instructions comprising:

a plurality of instructions which, when executed by one or more processors associated with one or more devices, cause the one or more processors to:

receive information that identifies a format of an identifier of a base station,

the format of the identifier indicating one or more bits, of a plurality of bits, of the identifier that identify a type of the base station,

the one or more bits being arranged adjacent to each other or being arranged non-adjacent to each other;

receive the identifier of the base station based on a user device connecting with the base station to communicate with the one or more devices via the base station;

determine, based on the format of the identifier, the type of the base station connected to the user device based on the one or more bits, of the plurality of bits of the identifier, that identify the type of the base station;

receive a call instruction,

the call instruction directing the one or more devices to identify a point of interest (POI) based on a location of the user device;

determine a processing instruction, relating to the POI, based on the call instruction and the type of the base station; and

execute a processing instruction based on the type of the base station connected to the user device.

17. The non-transitory computer-readable medium of claim **16**, where the instructions further comprise:

one or more instructions to identify the POI based on the location of the user device,

where one or more instructions, of the plurality of instructions, to execute the processing instruction, further cause the one or more processors to provide information regarding the POI to the user device or place a call to the POI for the user device.

18. The non-transitory computer-readable medium of claim **16**, where the processing instruction directs the one or more devices to determine the location of the user device based on the type of the base station, and

where one or more instructions, of the plurality of instructions, to execute the processing instruction further cause the one or more processors to determine the location of the user device based on the type of the base station.

19. The non-transitory computer-readable medium of claim **18**, where one or more instructions, of the plurality of instructions, to determine the location of the user device, further cause the one or more processors to determine the location of the user device based on a particular location determination technique,

the particular location determination technique being based on the type of the base station,

the particular location determination technique being based on one or more of: a secure user plane location (SUPL) protocol, longitude and latitude coordinates associated with the base station, or global positioning system (GPS) coordinates provided by the user device.

20. The non-transitory computer-readable medium of claim **16**, where the processing instruction directs the one or more devices to apply a quality of service (QoS) treatment or policy to a connection associated with the user device, and

where one or more instructions, of the plurality of instructions, to execute the processing instruction further cause the one or more processors to apply the QoS treatment or policy to the connection associated with the user device.

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